

Lower Carboniferous group with the sandstones answering to the same description that rest unconformably on the Lower Old Red of Forfarshire is regarded as established notwithstanding the occurrence in their associated limestones (in Nithsdale and elsewhere) of carboniferous limestone fossils. This bold course may be taken as a protest, on Prof. Geikie's part, that such questions are not to be settled on palaeontological grounds alone.

Along the southern edge of the Grampians the present map shows that the fault which for a long distance separates the Silurian slates from the Old Red Sandstones and conglomerates, runs all the way from Strathearn to Glen Esk (a distance of about fifty miles), within the old red area. Here then we have a noble exposure of the base of that formation abutting against its Silurian shores ; and we learn from its interbedded igneous rocks and trappean conglomerates, that even thus early, volcanic activity had set in on the margin of the Highlands. As far north as the Orkney Isles, the sub-divisions of the old red have been re-arranged, Prof. Geikie having himself observed the unconformability of the red sandstones (Upper Old Red) on the Caithness Flags on the west coast of Hoy.

In the Silurian Highlands many of the chief folds and variations of the metamorphic rocks are clearly indicated, and old mineralogical observations are corrected, largely through Prof. Geikie's own frequent traverses. The Laurentian and Cambrian rocks of the north-west coasts and islands seem to have suffered no changes since the publication of the sketch-map, except slight rectifications of boundaries required by the larger scale.

Much light has been thrown within the last few years on the mesozoic and tertiary rocks of the Moray Firth, Skye, Mull, and Arran, and this new information has been skilfully embodied in the map. Besides his own work in this department Prof. Geikie justly acknowledges his obligations to Ramsay, Judd, Bryce, and Zirkel.

It has been found possible to indicate at least two phases of the Glacial epoch, that of the main extension of the ice-sheet, and that of the later local glaciers. Of the direction of the ice-flow during the former phase an idea may be gathered from the arrows denoting observed glacial striae, while the moraines of the later period are shown by a neat system of stippling. Both in the Highlands and the Southern Uplands the number of valleys containing glaciers seems to have been very great. Scotland must have been a magnificent country for tourists in these pre-historic times.

In conclusion, we need only say that geological students have now in their hands a portable map that will supply them with much valuable information, and with suggestions equally valuable with regard to problems awaiting solution. Prof. Geikie is to be congratulated on the successful completion of a task for which he was peculiarly qualified, both by his position as Director of the Survey and by his thorough acquaintance with the minutest details of Scottish geology. R. L. J.

OUR BOOK SHELF

Botanical Reminiscences in British Guiana. By Richard Schomburgk. (Adelaide : 1876.)

THE able and indefatigable superintendent of the Botanic Garden at Adelaide was appointed, many years since, by

the Prussian Government, naturalist to the Boundary Expedition to British Guiana entrusted by the British Government to his late brother, Sir Robert Schomburgk ; and in this small, but extremely interesting volume, he gives an account of that "El Dorado," as he appropriately terms it, of tropical botany. Dr. Schomburgk's description of the floral treasures of the district, and especially of the Roraima mountains, where forms of the most wonderful beauty unfold themselves at every step, and undergo the most rapid transformations with every change of altitude, are enough to make the mouths of stay-at-home botanists water. The expedition was not, however, without its difficulties and dangers. On the Roraima mountain, which rises to the height of about 8,000 feet a few degrees north of the equator, the humidity of the air was so great that the artist who accompanied the expedition found sketching on the saturated paper impossible, while the powder in a loaded gun became changed, in a few hours, into a greasy mass. The ascent of the upper part of this mountain chain was a feat worthy of the most enterprising members of the Alpine Club. A perpendicular wall of sandstone rock, 500 feet in height, had to be scaled by the entire party by means of the net-work of climbing plants which covered it ; the giving way of a single root would have involved one or more of the party in certain death. The account of this expedition dissipates the idea that food is everywhere abundant within the tropics, even in thickly-wooded and well-watered countries. For days together the party saw no mammals or birds, and were reduced to the point of starvation from the absence of all esculent vegetables. One observation of Dr. Schomburgk's is important, as being at variance with our modern theories regarding the purpose of the bright coloration of flowers. Near the summit of the mountain range, where the earth was carpeted with flowers of gigantic size, of the greatest brilliancy of colour and delicacy of scent, "it appeared almost as if this boundless abundance of flowers compensated for the total absence of animal life ; all was wrapt in deep solemnity ; not even a gorgeous humming-bird or a graceful honey-sucker was seen fluttering amongst the flowers." Has this singular observation been confirmed by other American travellers ? Dr. Schomburgk's observations were not entirely confined to the flora of the country. While stopping at a Warrau settlement on the Barima river, he records the curious fact of a young woman nursing at one breast a child and at the other a young monkey ; and states furthermore, that he has seen, "with the exception of the carnivorous, all kinds of animals suckled and reared by Indian women." While ascending the Roraima mountains his attention was arrested by rows of Indian hieroglyphic writing on the sandstone rock, roughly representing, for the most part, the human form, kaimans, and snakes. There is one defect in this interesting volume, which should have been rectified before going to press. Either from want of exact knowledge of the language on the part of the author, or from the deficiencies of a colonial printing-office, many of the sentences are so inaccurately worded as to be barely intelligible.

A. W. B.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

On the word "Force"

IN the *Times'* report (Sept. 9, 1876) of Prof. Tait's lecture at Glasgow on Force, it is stated that "the lecturer showed how the incorrect physical ideas of Leibnitz, and some of his followers, had introduced the terms *vis viva*, *vis mortua*, and *vis acceleratrix*," and that these terms were found also in English works. We may add that, until quite lately, Cambridge treatises

on Mechanics always used the expressions "accelerating force" and "moving force" (to the great confusion of learners), with the noteworthy exception of Sandeman's "Motion of a Particle," where "effect" was used for "force." So troublesome and misleading was this terminology found for students that one well-known Cambridge writer in a little work on Dynamics, introduced it in a way which reminds one of the trembling and caution with which Sidney Smith brought the word "metaphysics" before his audience at the Royal Institution. But these authors could claim the venerable authority of Newton for those terms; and if they had taken care to introduce them in the exact way in which he does, no difficulty would have ensued. Unfortunately, until Mr. P. T. Main edited Newton's "Sections," our editions of that work began with Lemma I., and ignored his "Definitions" and "Laws of Motion." In the "Definitions" Sir I. Newton tells us that the term "accelerative force" is used as an abbreviation for "the accelerative quantity of a force," or the velocity generated by it in a given time; and the term "moving" or "motive force" as an abbreviation for "the motive quantity of a force," or the momentum generated by it in a given time; and if these expressions had always been explained in this way, i.e. as signifying what may be called the *velocity-effect* and the *momentum-effect* of a force, there would have been no room for misconception and no need of cautioning the learner against the notion that there were two different kinds of force. Perhaps with regard to Leibnitz it may be questioned whether his physical ideas were so incorrect, and whether he may not have used the terms referred to in the same way that Newton did, viz., as abbreviations, and so as to embody the notions of the different effects of a power or influence on the motion of a body, viz., its work-effect, its momentum-effect, its velocity-effect, &c. It must, however, be allowed that the term "conservation of force" (originally it seems due to Helmholtz) is very misleading, for a meaning of "force" is therein required which is not included in the original dynamical ideas; and the notion intended to be conveyed could only be given by a new term, "energy," or work-power, with its attributives actual and potential. But, after all, the whole controversy on the word "force" is as to the method of measuring a pressure or tension; if we regard the time of the action, the effect is represented by the momentum; and if the space through which exertion is made, the effect is represented by the work.¹ Either of these would then measure "force," and there would be no inaccuracy if careful explanation were given as to the method used and the sense of words.

W. P. O.

Arnesby, Rugby

P.S.—In Prof. Tait's view of "force" is there not a confusion between being a mere rate and being measured by a rate?

[Our correspondent refers merely to the short abstract given by the *Times* of Prof. Tait's Lecture. Some of his remarks will be found inapplicable to the fuller report in our own pages.—ED.]

Mr. Wallace and his Reviewer

IN NATURE, vol. xiv. pp. 188, 189, in a review of Mr. Wallace's recent work on "The Geographical Distribution of Animals," occurs the following paragraph: "Mr. Wallace admits the validity of *Elasmognathus* of Gill as a genus of Tapirs, and adopts Dr. Gray's multitudinous division of the well-defined and eminently natural group of the Eared Seals (*Otaria*). Many naturalists would hesitate before following Mr. Gill or Dr. Gray as authorities on these (or perhaps we may add many other) subjects."

I freely admit the truth of the proposition that there are "many subjects" on which I am not authority, if I am on any; there are none, I presume, who are authority on all things. I will not even contest the allegation as to wrong-doings in regard to the generic differentiation of Baird's tapir; I beg, however, to be allowed to excuse myself by "authority" for such wrong-doing.

The animal in question is distinguished from all others (I have seen skins and skeletons of every known species, and about 100 skulls), and especially from the typical American tapirs by the want of basal apophyses to the nasal bones, the extension of the supramaxillaries behind, into their lowellæ, and their extension upwards into swollen portions, which tightly embrace the mesethmoid, the complete ossification of the latter in the adult; with these features are co-ordinated others less marked, e.g., abbreviation of the cranial box, comparatively small size of the cere-

¹ "Walton's Mechanical Problems," chap. x.

bral cavity, &c. The genus has been accepted by Prof. Verrill, Dr. von. Frantzius, Dr. Murie (see his article in *Journ. of Anat. and Phys.*, vol. vi., pp. 131–169), as well as Dr. Gray, and every trained mammalogist and anatomist to whom I have shown the skulls (e.g. the late Prof. Agassiz, Prof. Baird, Prof. Cope, E. Coues, Dr. H. Allen, Mr. J. A. Allen) have concurred with me that the type is entitled to generic distinction.

As to the eared seals, the critic is wrong as to a matter of fact. Mr. Wallace has not followed Dr. Gray in his arrangement of the constituents of that family, but, as he expressly states, has followed Mr. J. A. Allen's elaborate monograph of the *Otaridiæ* of Western America. Two more different arrangements of the same group could scarcely be. For the generic features of the arrangement adopted, I am quite willing to assume the responsibility which Mr. Allen has devolved upon me,¹ notwithstanding the critic's emphatic condemnation. Beside Dr. Gray and myself, F. Cuvier and many of the other older naturalists, as well as Allen, Scammon, Elliott, &c., have recognised generic differences between the *Otaridiæ*.

But over and above all these I can plead in extenuation of my wrong-doing the example of a very eminent and accomplished naturalist, Mr. P. L. Sclater; I feel assured that I am not mistaken in supposing he will be regarded as the best possible authority on such subjects. That zoologist has differentiated the deer into genera distinguished solely by the palmation or non-palmation of the horns and many genera of birds on equally slight ground which your limits forbid me to mention. I think no rational naturalist familiar with the details of structure of the deer and tapirs and the variations of horns in the former, will contend that the differences between the tapirs is of less systematic importance than those used to differentiate *Cervus* and *Dama*. Hence I think I have the best precedents for my action, and if I am subject to censure, the eminent Englishman whom I have cited is still more so.

But far be it from me to deny that my critic is not at all correct in his statement (shortly preceding the passage first quoted) that "it would be easy to point out many passages in which Mr. Wallace has not, in our opinion, made the most judicious choice of authorities." One passage (*Op. cit.*, vol. ii. p. 120) I beg to reproduce in corroboration, but, in justice to Mr. Wallace, I must add that although there are many other errors, the passage thus quoted is an exceptional one in a valuable work.

"*Fresh-water Fishes*,²—The Nearctic region possesses no less than (1) five peculiar family types, and (2) twenty-four peculiar genera of this class. The families are *Aphredoderidae*, consisting of a single species found in the (3) Eastern States; *Percopsidae*, founded on a species (4) peculiar to Lake Superior; *Heteropygiæ*, containing (5) two genera peculiar to the Eastern States; *Hiodontidae* and *Amiidae*, each consisting of a single species. The genera are as follows: (6) *Paralabrax*, found in California; (7) *Huro*, peculiar to Lake Huron; (8) *Pilcomia*, *Bolcosoma*, (9) *Bryttus* and (10) *Pomotis* in the Eastern States—all belonging to the Perch family, (11) *Hypodilus* and *Noturus*, belonging to the *Siluridae*, (12) *Thaleichthys*, one of the *Salmonidae* peculiar to the Columbia River, (13) *Moxostoma*, (14) *Pimephales*, (15) *Hyborhynchus*, (16) *Rhinichthys*, in the Eastern States; (17) *Ericymia*, (18) *Exoglossum*, (19) *Leucosomus*, and (20) *Carpoides*, more widely distributed; *Cochlognathus*, in Texas; (21) *Mylaphorodon* and *Orthodon*, in California; *Meda*, in the River Gila; and *Acrochilus*, in the Columbia River—all belonging to the *Cyprinidae*. *Scaphirhynchus*, found only in the Mississippi and its tributaries, belongs to the sturgeon family (*Acipenseridae*)."

Whatever may be the "authority" followed, the following are the facts almost all familiar to every American ichthyologist, and matters of record respecting the forms enumerated. (1) Five families are mentioned in one place (just quoted), and six in others (*op. cit.*, vol. ii., pp. 115, 143); but the sixth (*Lepidostericidae*) is not peculiar; (2) Twenty-four genera are said to be peculiar, but twenty-nine are enumerated, as is indeed recognised in the next paragraph of the work. (3) The family *Aphredoderidae* is represented by two species found in the Western and Southern as well as Eastern States; (4) The *Percopsidae*, far from being confined to Lake Superior, are found at least as far as Lake Champlain to the east, the

¹ "These [genera recognised by Gill] appear to be natural groups of true generic rank, and properly restricted; and, after a careful examination of the subject, and specimens of four of these five types, they appear to me to include all the natural genera of the family."—Allen, "On the Eared Seals (*Otaridiæ*)," p. 38.

² The punctuation of the original is reproduced.